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ABSTRACT

The objective of this study was to explore a new method of analyzing the performance of substate economies. Conventional analyses of economic diversity and growth are limited by their reliance on static measures of economic structure. Such measures do not capture the patterns of growth dynamics or structural change a region may be experiencing. This paper discusses a new measure of dynamic economic diversity and explores its relationship to economic performance. The measure is a statistical index that reflects the degree to which employment in a county's industries move together, over time. The more the industries' employment levels move together the higher the index value, which hypothetically indicates a higher degree of regional economic integration. The analysis was applied to county-level data from three states: Iowa, Minnesota, and Wisconsin. The findings were: (1) Metro(politan) areas showed the highest values of the dynamic coherence index, and farm counties had the lowest values. Non-farm/non-metro counties were in the middle range; (2) High-coherence counties tend to have higher levels of per-capita income; and (3) Dynamic coherence appears to be positively related to the rate of economic growth as measured by employment growth rates. These findings may indicate that conventional static measures do not capture the economic linkages between industry sectors that make them move together. The correlations between the index of dynamic coherence, income growth, and employment growth may reflect the importance of interindustry linkages to the growth process. (Author/TES)

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by Richard McHugh, Ronald Cooper, Sheila Martin, Daniel Otto, and Stanley R. Johnson

Staff Report 90-SR 41
January 1990

Staff Report

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Abstract

The objective of this study was to explore a new method of analyzing the performance of substate economies. A major limitation of conventional analyses of economic diversity and growth is the reliance on static measures of economic structure. Such measures do not capture the patterns of growth dynamics or structural change the region may be experiencing.

This paper discusses a new measure of dynamic economic diversity and explores its relationship to economic performance. The measure is a statistical index that reflects the degree to which employment in a county's industries move together over time. The more the industries' employment levels move together, the higher the value of the index. A high index indicates a high degree of regional economic integration.

The analysis was applied to county-level data from three states: Iowa, Minnesota, and Wisconsin. The findings:

- Metro areas showed the highest values of the dynamic coherence index, and farm counties had the lowest values. Nonfarm/nonmetro counties were in the middle range.
- High-coherence counties tend to have higher levels of per capita income.
- Dynamic coherence appears to be positively related to the rate of economic growth as measured by employment growth rates.

These findings may indicate that conventional static measures do not capture the economic linkages between industry sectors that make them move together. The positive correlations between the index of dynamic coherence and both income and employment growth may be reflecting the importance of interindustry linkages to the growth process.

Introduction

The secular economic decline that has occurred in many rural areas during a period in which the rest of the United States has experienced expansion has stimulated a broad public policy debate on rural development issues. Governments at all levels have been under pressure to initiate policies that can facilitate economic development in rural America. National rural development policy has usually involved strategies to diminish differences in economic activity, growth, and rates of return on human and physical capital between urban and rural areas. However, there are substantial differences among rural areas, suggesting that specialized policies and programs may be required if efforts to improve these economies are to be successful. These specialized policies will require added information on the structure of substate economies as well as new concepts for understanding their structural dynamics.

A number of studies have attempted to identify differences in the characteristics of rural economies and to relate these characteristics to economic performance. Bender et al. in 1985 developed a classification system for counties reflecting economic base. From analysis with this system, Bender et al. concluded that since no local economy is a microcosm of the aggregate economy, policies addressing national economic problems do not generally meet the development needs of rural economies. These authors also found that rural counties are often so small that, within the observable time frame, development did not always lead to

diversification, a feature that has been argued to be consistent with the development process. Thus, policies appropriate at national and even state levels will not necessarily be consistent with county or other substate economic development initiatives. Furthermore, an improved understanding of the characteristics of rural communities that reflect the dynamic structure of the economy is necessary for adapting and specializing economic development policy.

Descriptive systems that classify local economies can contribute to a fuller appreciation for the uniqueness of local economies. With this descriptive objective, Bender et al. grouped nonmetropolitan counties into seven categories, with an eighth residual category:

- counties heavily dependent on farming
- counties heavily dependent on manufacturing
- counties dependent on mining
- counties specializing in government functions
- counties with persistent poverty
- counties with federal lands
- retirement settlements

Overlaps in the classification system were permitted and rationalized as simply indicating complexities of defining the economic base and structure of substate communities. More than 57 percent of the nonmetropolitan counties belonged to only one of these categories. It was argued that this classification of counties could help in the formulation of specialized economic development policies targeted on the basis of these observed structural features.

Sommer and Hines (1988) have provided an alternative classification of counties, again designed to assist in the formulation of specialized development policies. Their classification scheme is based upon the conjecture that an important determinant of the economic performance of many rural counties has been the level of agricultural exports. Their classification system identified farming, export-directed farming, and a combination of the two as key features of the economic structure. A county was classified as export-driven if at least 50 percent of total farm sales were from the five major export-oriented crops: corn, wheat, soybeans, rice, and cotton. With federal budget pressure and other pressures to reduce agricultural and export subsidies, knowledge of this dependency was suggested as important in assisting governments at all levels in anticipating future county development assistance requirements.

The National Governors' Association (NGA) has issued a report with a slightly different approach to county classification (John 1988). The NGA report classified counties not according to their static characteristics, but instead according to their behavior over time. Differences in growth performance were viewed as implying something about the success of past economic development policies. Two methods of identifying success stories for counties were used, and common features in the histories of the counties were described. From case profiles of high-performing counties, it was observed that past economic development policies were common to the counties studied. That is, other factors combined with these policies to yield success in some counties and not in others. The implication was that added information on the features of the counties was necessary for a

more complete understanding of the factors contributing to successful development.

In this report the NGA dynamic classification system, using county economic development history, is extended by linking trends in employment by industry to economic performance. While sectoral employment data are often used in examining the development process, the potential of these data for evaluating economic development policy has not been fully explored. A more complete understanding of county economies, obtained by examining closely how the employment patterns by sector move together, can be used to indicate how employment in individual sectors is related to ultimate changes in total employment and personal income.

Objectives and Approach

The object of this project was to develop a measure of patterns of employment growth and change among sectors, and then to test the relationship between this measure of economic structure and the overall performance of the local economies. This alternative classification system measures the degree of dynamic interaction among industry sectors for the local economy. The system is different from those previously developed in that it measures the economic coherence of the local economies.

The systems that have been used to categorize or classify local or regional economies have been largely static in nature (see Richardson 1979). Classifications such as "tourism-dependent" convey something about the makeup of the economic base but suggest little about growth or development other than that increased tourism would be favorable. Other

systems classify counties using recent aggregate economic performance: rapidly growing, stagnant, cyclically sensitive, and so on. These classification systems, although identifying trends in employment, say little about the structure of employment; that is, whether or not the growth in employment affects a large number of sectors or is concentrated in a particular sector.

For small or intermediate-sized economies, aggregate employment may increase, for example, due to the good fortune of a particular local firm or because of a new employer. However, beyond this initial impetus for growth, the impact on the regional economy can vary significantly. To illustrate, consider two local economies, both enjoying growth in employment from a new or expanding industry. The increase in economic activity attendant to the growth in employment will have benefits for many of the other sectors. For one economy, suppose direct interaction among the different sectors is small. A manufacturing firm, for instance, may have a large number of employees, but the local linkages may be weak. The manufacturer may buy primary inputs from another region, employ firms outside of the region for business services, or contract out for other professional services. In the other economy, linkages to other sectors are strong. In a static sense, this interaction among the sectors within the region indicates the degree to which the growth of one firm will spill over into other sectors through impacts on incomes of the residents. In the words of the regional economist, the lack of interconnectedness and differences in total employment and income growth between the two

economies would be explained by differences in the local economic multiplier.

Much of the literature on economic development that attempts to measure the degree to which an economy has developed in a well-integrated way relies upon "snapshots" of the employment patterns among communities. Then, from analyses of these snapshots, one can infer the degree to which a community is dominated by a particular industry. For example, one frequently employed measure of industry dominance is the "location quotient," the ratio of the percentage of total employment in an industry to that same percentage for the average community (typically the percentage nationally). If the location quotient is above 1.0, the industry is a dominant economic force in the community. Unfortunately, this measure does not give an indication of the degree to which a community has developed regional linkages and the degree to which a pattern of development would imply that growth in one industry would directly spark growth in other industries.

Input-output is one technique for assessing interregional linkages. However, for practical purposes, input-output analysis cannot be used to investigate trends in the development of such support networks. In general, input-output models are either too expensive or must rely on tenuous assumptions about the structure of production and trade among regions. Community-specific input-output analyses rely on costly survey methods for the collection of required data, and intertemporal applications require the maintenance of costly survey updates. The alternative to the survey-based input-output models is nonsurvey

techniques, which necessitate assumptions inappropriate for interregional analysis. For example, most nonsurvey input-output models use the assumption that firms always satisfy their input demands locally first. But, the propensity to purchase locally first is what we want to measure, not what we want to assume. In short, dynamic input-output analysis for small communities is impractical as a tool for studying economic development.

In this present project a new approach for measurement of patterns in economic growth is elaborated and investigated. Observed trends in economic growth, by sector, over an extended period of time are examined for coherence. The measure of coherence is then linked to economic growth.

If a small but expanding community has developed economic coherence, then we would expect the fortunes of each of the industrial sectors in the community to be related. That is, there would be a high degree of comovement among the economic sectors of the community. Location quotients or aggregate growth rates would not indicate the nature of the growth process and whether the patterns of development were haphazard or coordinated. The stability of the employment relationships among sectors (an indicator of a mature economic community) can be detected by directly measuring the comovement.

The degree of cohesiveness, exhibited by the comovement of employment across sectors, can be measured using principal components. In principal components analysis, fixed linear combinations of sets of variables are created. These linear combinations, or principal components, are

estimated from sample data to explain the greatest degree of variation of all of the variables. The measure of the degree to which a principal component captures the variation of all of the variables is reflected in the eigenvalue. These eigenvalues (normalized) can be interpreted as percentages of total variation explained by the principal component of index (Fomby, Hill, and Johnson 1984).

A principal component explains a high proportion of the variation in employment among sectors or industries if the associated eigenvalue is high. In terms of growth process, a local economy (county) that has developed a high degree of dynamic economic coherence will generate high eigenvalues for first principal components when estimated from time series of employment data, by industry. Particularly for smaller economies, economic coherence could be interpreted as indicative of a good industrial or institutional support network. If the observed pattern of employment change generates a high eigenvalue for the first principal component, the community is said to have a high level of economic coherence. If, on the other hand, the first principal component is low, the community is said to have a low level of economic coherence.

In this project, county economic performance was analyzed for three midwestern states: Iowa, Wisconsin, and Minnesota. Monthly employment data for the period 1977 to 1987 were used. The employment data were at the one-digit level of industrial detail: agriculture and mining; manufacturing; construction; wholesale trade; retail trade; finance, insurance, and real estate; and transportation, communication, and public

utilities. (For Minnesota, employment in the trade sector could not be disaggregated into wholesale and retail trade components.)

The level of economic coherence was measured by the proportion of the total variation in employment among all sectors statistically explained by the linear combination of these sectors explaining the highest proportion of the historical or sample sectoral employment change. An interesting issue was the implication of coherence for the economic well-being of the county. Were counties categorized as having a high degree of economic coherence likely to have grown more rapidly? Is a high level of economic activity more or less viable in these communities?

To address this economic development issue, the rate of growth in employment and the secular instability of employment over a ten-year period were estimated and statistically related to the measure of economic coherence. The rate of growth of employment for each county was estimated from a regression of the log of total employment on a time trend index. The estimated coefficient for the time trend variable from this type of model can be interpreted as a growth rate for total employment. This regression technique for measuring employment trends is preferable to a simple point-to-point or date-to-date calculation of employment change because the results are less sensitive to the selection of the beginning and ending dates.

Stability of total employment levels in a county was measured as the average absolute percentage deviation of actual employment from that predicted by the regression. That is, total employment instability was the average variation in total employment around the detrended total

employment level. This measure would identify counties that had erratic employment patterns over time with high total employment variation.

Results

Two sets of results from the project are presented and discussed. First, descriptive results are reported in secular form. The idea is to show for the three states how the coherence was related to type of county--farm, metropolitan, and nonmetropolitan. Second, the measure of coherence was related to overall economic growth. Results from this analysis are provided in tabular form and graphically.

Coherence by the Type of County

For this descriptive analysis all counties were placed into three categories--farm counties (defined as those within which at least 20 percent of wage and salary plus proprietorship income was from farm sources); metropolitan counties (those located in a metropolitan statistical area as defined by the Department of Commerce); and nonmetropolitan/nonfarm counties (i.e., rural, nonfarm communities). Initially, the level of the index of economic coherence was computed for each county in the three states for the period 1977 to 1987. A high coherence index indicated that sectoral employment moves together and that there was a high degree of comovement of employment across all sectors.

The average values of the index of coherence, by type of county and state, are reported in Table 1. In all three states, the rankings of the industries by type of county were the same. The highest levels for the index of coherence were found for the metropolitan areas. This is

Table 1. Estimated index of coherence by state and type of county

Type of county	Iowa	Minnesota	Wisconsin
Farm	.460	.466	.456
Metropolitan	.548	.610	.583
Nonmetropolitan/Nonfarm	.510	.489	.507

consistent with the interpretation that these larger economic areas have developed a broad enough economic base to allow for a substantial direct interaction among industries within the region. In this case, the need to develop important linkages outside the county would have been lower. In other words, leakages from the economic system would likely have been lower, giving the counties more of an opportunity to grow in reaction to external or exogenous stimuli.

At the other extreme, the farm counties have the lowest values of the coherence index. In these rural farm communities, employment by sector moved more independently. Again, this is consistent with the interpretation that direct interindustry linkages were less likely in geographically diffuse areas. Sectoral employment levels, although by no means independent of one another, exhibited less uniformity of movement. In terms of implications for economic development, the lack of interaction is neither conducive to internally generated growth that might, through a multiplier process, create more employment, nor does this irregular pattern of employment development across sectors indicate that the areas have established an economic and institutional base that would support economic development through industrial recruitment.

Referring again to Table 1, in the middle in terms of the level of the index of coherence are the nonmetropolitan/nonfarm counties. These are perhaps the most interesting counties. Unlike the existing metropolitan areas, which have already developed, it is a matter of speculation whether the nonmetropolitan/nonfarm counties will grow in a manner to attain the critical mass and agglomeration potential to permit

the establishment of local direct linkages and a capacity for coordinated economic growth.

Dynamic Coherence and Economic Growth

The issue of primary interest was the extent to which the classification of counties using coherence could be related to the aggregate economic performance. For purposes of interpretation, observe first that the measure of economic coherence is directionless. That is, the level of the coherence index merely characterizes a pattern of sectoral employment shares and makes no reference at all to overall economic trends. The data for the calculation of the index have no time identifier and the orderings of the sample of historical observations is irrelevant. In short, the deck of data cards could be shuffled or reversed in order and the same measure of coherence would have emerged. Thus, while the index reflects qualitative interindustry patterns of employment levels, it gives no information on trends. Likewise, by itself coherence does not reveal whether over time a high index would indicate a favorable or unfavorable environment for economic growth.

To examine the relationship between the index of coherence and the level of economic activity, both static and dynamic analyses were performed. First, the relationship between the level of the index of coherence and the level of per capita income was examined. Second, the relationship between the level of the index and the trend rate of growth in employment over the time period was evaluated. Both link coherence, an indicator of underlying economic structure, to economic development.

In Table 2, the level of per capita income for counties with both high and low levels of the index of coherence is shown. High and low coherence were in each case determined relative to the average (mean) value for the counties by type and state. In general, at a state level the per capita income levels were higher in the counties with higher indices of coherence.

There is a danger in drawing broad conclusions from Table 2 in that the higher level of per capita income for the counties with higher indices of economic coherence was merely a manifestation of the fact that income tended to be higher in metropolitan areas, and that metropolitan areas had high indices of economic coherence. Also from Table 2, observe that in most cases the level of per capita income was higher in areas with a higher coherence index, even within classes of counties. Where the exception to this rule was observed, differences were small in magnitude.

Perhaps the most important issue to be addressed, in terms of economic development processes and policies, is the relationship between the index of coherence and economic growth. The statistical relationship between county growth in total employment and interindustry coherence was estimated by state and type of county. The coefficients of correlation between the indices of coherence and the trend rates of growth in total employment over the ten-year period are reported in Table 3. These correlations show the extent to which the patterns of economic development were related to this indicator (total employment growth) of the trend in economic activity.

Table 2. Average per capita personal income by level of the index of coherence by type of county and state

State/Type of county	Low coherence[a]	High coherence[a]
Iowa		
All counties	$12,528	$12,720
Farm	12,436	12,962
Metropolitan	12,550	12,724
Nonmetropolitan/Nonfarm	12,598	12,474
Minnesota		
All counties	12,721	12,915
Farm	12,602	12,611
Metropolitan	13,315	13,390
Nonmetropolitan/Nonfarm	12,245	12,743
Wisconsin		
All counties	12,554	12,793
Farm	12,288	12,160
Metropolitan	13,113	13,910
Nonmetropolitan/Nonfarm	12,259	12,310

[a]High- and low-coherence counties were above and below the average, respectively, by state and by type of county.

Table 3. Coefficient of correlation between index of dynamic structural coherence and rates of total employment growth

	Iowa	Minnesota	Wisconsin
State	.162 (.107)[a]	-.160 (.425)	.119 (.323)
Type of county			
Farm	.241 (.077)	-.448 (.552)	-.521 (.056)
Metropolitan	.295 (.378)	.914 (.266)	.532 (.019)
Nonmetropolitan	.011 (.949)	.478 (.106)	.061 (.717)

[a]The unbracketed figure is the value of the coefficient of correlation. The bracketed figure is the corresponding statistical level of confidence that the estimated correlation coefficient is not zero.

The results in Table 3 were not conclusive, but they favor the interpretation that a high degree of economic coherence is associated with a higher rate of economic growth. Although not many of the coefficients of correlation were statistically significant at high levels of confidence (not surprising given the small number of observations for each state and county type), the evidence suggested a positive correlation between the indicator of economic growth (the rate of growth of total employment) and the index of coherence. In Minnesota and Wisconsin, the estimated coefficient of correlation between the index and growth was highly statistically significant for the state as a whole and positive.

In an effort to more closely examine economic coherence and total employment growth, a qualitative relationship between the rate of growth in total employment in each county and the change in the index of economic coherence was developed. Specifically, the indices of coherence were calculated for each county during two five-year subperiods, 1977-1982 and 1982-1987. A county was categorized as having an index above or below the average relative to the corresponding state and county type (farm, metropolitan, and nonmetropolitan/nonfarm) for each of the subperiods. Thus counties for the two periods could be categorized into four types:

- below average indices for both periods
- above average indices for both periods
- below average in the first period and above average in the second
- above average in the first period and below average in the second

The relationships between this two-period categorization of counties by pattern of employment change and the rate of growth in total employment are reported in Table 4. Table 4 is for counties pooled for all three states. The state-by-state detail for the classifications is given in Appendix Tables A.1 through A.3. This quantitative analysis comparing coherence and total employment change uncovered several interesting regularities. Ignoring, for the moment, the farm communities, there was a relatively strong relationship between those counties that had indices of dynamic economic coherence above average in both time periods and employment growth rates. For the metropolitan and nonmetropolitan/nonfarm counties, 27 out of 37 counties with above average indices of coherence in both periods had above-average total employment growth rates. It should be emphasized that each of these categorizations of high- and low-coherence indices and total employment growth rates were defined relative to the state-specific and county-type-specific class averages. This minimized the potential for spurious cross classifications, which might have resulted from broad structural trends in the macroeconomy. For example, large metropolitan areas have enjoyed relatively rapid growth during the past ten years, and they also have high levels of coherence.

The relationships shown in Table 4 are illustrated for Iowa in Figures 1 and 2. The two figures are for farm and nonmetropolitan/nonfarm counties, the emphasis of the project. Those counties not shaded are for the two other classes or types. Results illustrate the predominance of the positive relationship between coherence and economic growth as indicated by rates of total employment growth.

Table 4. Quantitative relationships between changes in the index of coherence and total employment growth rates: All states

Index of coherence/ Two periods	Farm		Metropolitan		Nonmetro/ Nonfarm	
	Above[a]	Below[a]	Above	Below	Above	Below
Always above average	9	16	10	4	17	6
Always below average	14	10	6	8	9	13
Below to above average	8	10	6	3	17	11
Above to below average	11	7	3	5	14	14

[a]Economic growth rates proxied by above- and below-average rates of total employment growth.

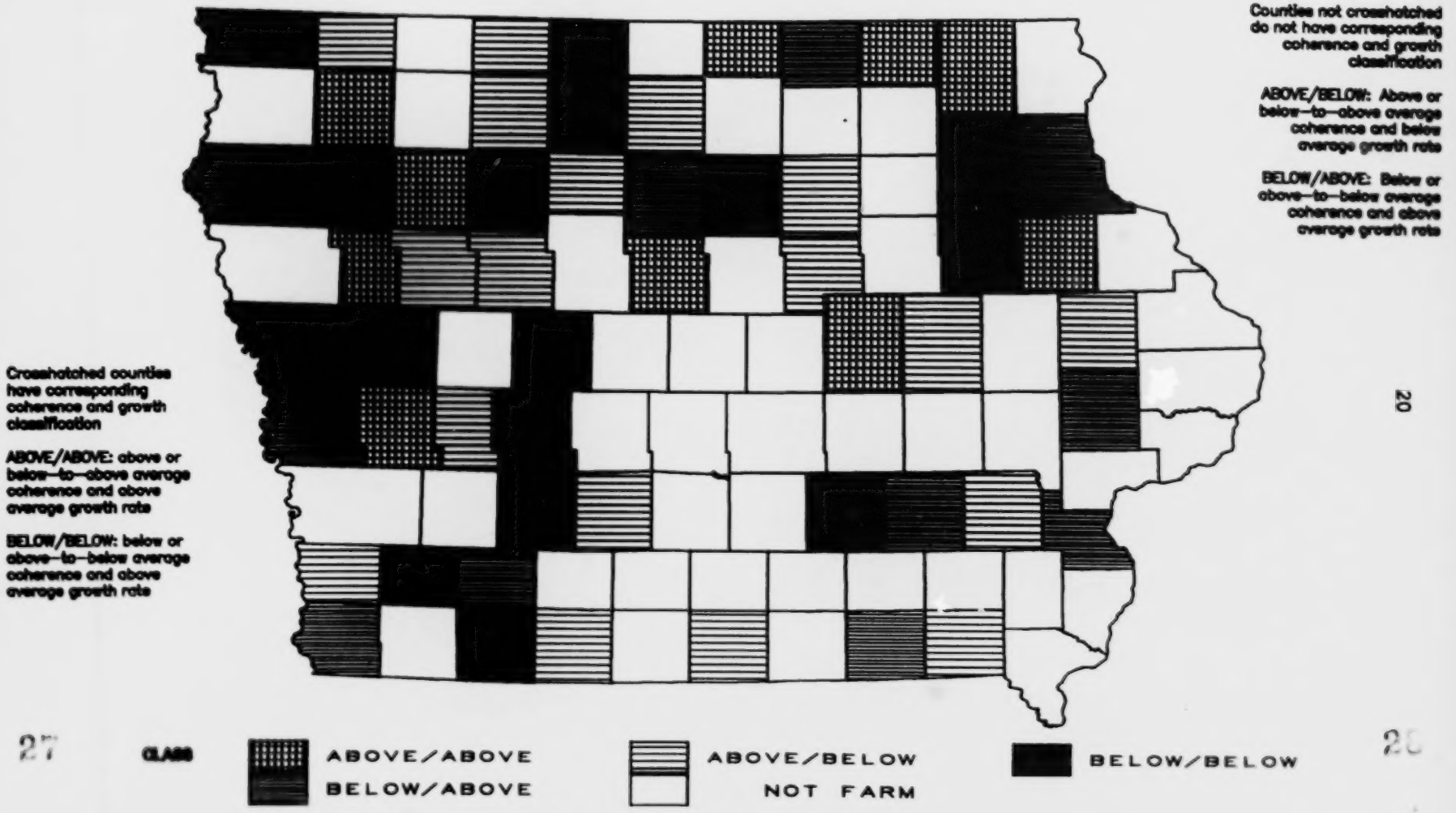
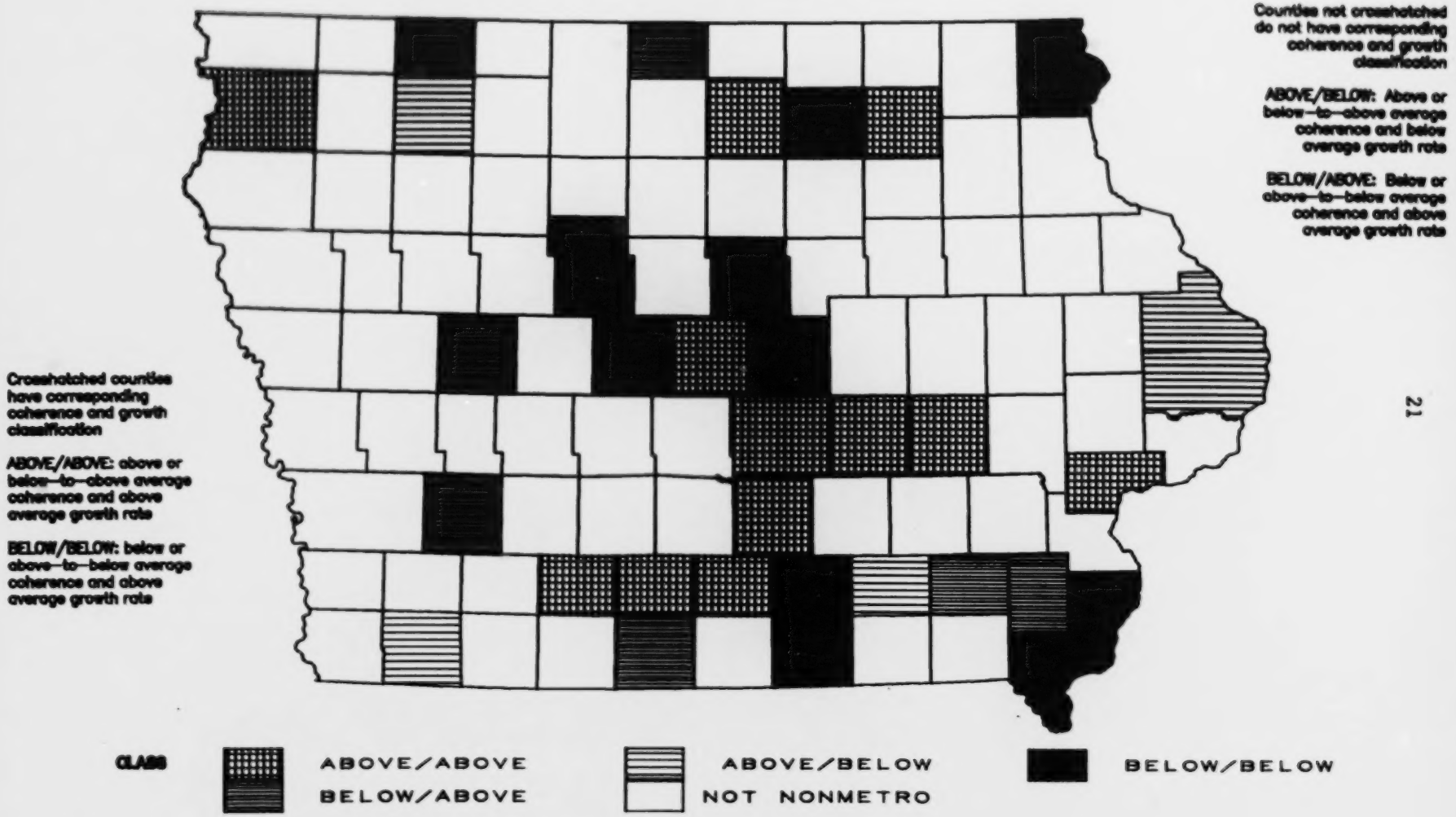

Crosshatched counties have corresponding coherence and growth classification
ABOVE/ABOVE: above or below-to-above average coherence and above average growth rate
BELOW/BELOW: below or above-to-below average coherence and above average growth rate
Counties not crosshatched do not have corresponding coherence and growth classification
ABOVE/BELOW: Above or below-to-above average coherence and below average growth rate
BELOW/ABOVE: Below or above-to-below average coherence and above average growth rate
CLASS
ABOVE/ABOVE
BELOW/ABOVE
ABOVE/BELOW
NOT FARM
BELOW/BELOW

Figure 1. Correspondence between coherence and employment growth, farm dependent counties: Iowa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Counties not crosshatched do not have corresponding coherence and growth classification
ABOVE/BELOW: Above or below-to-above average coherence and below average growth rate
BELOW/ABOVE: Below or above-to-below average coherence and above average growth rate
CLASS
ABOVE/ABOVE
BELOW/ABOVE
ABOVE/BELOW
NOT NONMETRO
BELOW/BELOW

Figure 2. Correspondence between coherence and employment growth, nonmetropolitan counties: Iowa

This positive relationship between the index of coherence and the economic growth rate proxy, shown in Tables A.1 through A.3, was robust, holding across metropolitan areas and nonmetropolitan/nonfarm areas in all but one of six possible cases (that being the case of metropolitan areas in Iowa, where one metropolitan county with an above-average index of coherence grew at an above-average rate and another grew at a below-average rate). It is in the nonmetropolitan/nonfarm counties that the relationship was strongest. In 17 of the 23 possible cases, counties with above-average indices of coherence in both periods had above-average growth rates. This supported the argument that it was in these small- to moderate-sized communities that the dynamic implications of economic coherence would most likely emerge.

The converse of those counties that maintained an above-average measure of coherence for the two periods or that moved from below- to above-average coherence were the cases for counties always exhibiting below-average coherence. An analysis of the growth trends in this latter group of counties showed results consistent with those already discussed. Specifically, in those counties that had an index of coherence below their state and class average in both the first and second time periods, employment growth rates were generally below average. Only 15 out of the 36 nonmetropolitan/nonfarm counties classified as having below-average coherence in both time periods had growth rates above the average for their class and state. Again, the exceptions to the rule occurred for Iowa metropolitan areas. The most consistent relationship again was found for the nonfarm/nonmetropolitan areas.

The next set of cases was for the counties in which there was a strengthening of the employment dynamics measured by the index of coherence and conversely a weakening of this relationship. In general, for those counties that moved from below-average to above-average coherence, employment growth was above average in 23 of 37 counties. Again, the strongest results were for the nonmetropolitan/nonfarm counties.

The relationships for metropolitan and nonmetropolitan/nonfarm counties did not hold for the farm counties. It may be the case that the farm communities were too dependent on farm output, climate, and farm export activity to permit the employment data to pick up subtleties linking economic growth to interindustry relationships.

Coherence and Employment Growth Stability

Next, the relationship between the indices of economic coherence and the level of employment stability over time was examined. The prior expectations on the direction of the correlation between the index of coherence and the level of employment instability were difficult to establish. On one hand, one might expect that a more mature and well-developed economic system or infrastructure (those hypothesized as characteristic of counties with a high level of economic coherence associated with growth) could better adjust to external shocks to the local economic system. On the other hand, the measure of coherence was interpreted as meaning that the community had developed a network of interrelationships and interdependencies and an institutional structure

that could magnify the effects of external shocks to the local economic system. If a small community were dependent upon one particular industry and these linkages had developed and were direct and strong, the danger of magnified swings in employment over the business cycle would grow.

To test for this relationship, the measure of the instability of employment--the average percentage deviation of actual employment from the level of employment predicted by the regression of employment on time trend--was used. The correlations between the index of economic coherence and the measure of economic instability are reported in Table 5. There was no obvious discernible pattern in these estimated values. Most of the coefficients of correlation were not significantly different from zero. Moreover, the few that approached significance had both positive and negative signs.

In sum, there was no apparent relationship between the level of dynamic economic coherence and the level of total employment instability. Thus, higher levels of economic coherence need not imply or be associated with aggregate economic instability. And similarly, low levels of economic coherence did not imply stability.

Static Measures of Economic Dependence and Coherence

The traditional measures of economic concentration or dependence are based simply upon static, or snapshot, views of an economy, not upon the nature and process of economic development. For example, two economies may have the same share of employment in a certain sector, and both may be presumed (based upon the snapshot) to be equivalently dependent upon that

Table 5. Coefficients of correlation between the index of coherence and a measure of total employment instability

State/County type	Iowa	Minnesota	Wisconsin
Total	-.173[a]	-.072	-.106
	(.085)	(.580)	(.383)
Farm	-.261	-.178	.089
	(.057)	(.495)	(.762)
Metropolitan	-.020	-.122	-.431
	(.953)	(.666)	(.065)
Nonmetropolitan	.053	-.097	-.010
	(.765)	(.618)	(.953)

[a]The unbracketed figure is the estimated value of the coefficient of correlation. The associated bracketed figure is the confidence level for a test that the estimated value is zero.

sector. Yet, as has been noted, the two economies need not be equivalently dependent if the local interindustry linkages differ between the two areas.

The extent to which the traditional static measures of diversity are related to the measure of dynamic coherence has been tested. A measure of the absence of static economic diversity (excessive concentration) based upon the location quotient (LQ) approach has been estimated. The LQ, measured as the ratio of employment in a sector relative to the same proportion nationally, is a measure of the dependence of a county upon a sector. Recall that an LQ above 1.0 for a sector is indicative of a specialization of employment in that sector. The expected value (in an arithmetic sense) for the LQ for each sector of the economy is equal to exactly 1.0. Thus, the index of concentration (the lack of diversity) was calculated as the sum of the absolute values of the deviation of each sector LQ from 1.0. If one sector were especially highly represented in the economy, the average expected value of the LQ of all of the other sectors would be pulled below 1.0. Since the measure used was the absolute value of the deviation in the location quotient from 1.0, concentrations in one sector were magnified by using this measure of static diversity by deviations in the other direction in other sectors. Summing the absolute deviations across all industries did not average out these concentrations.

In Table 6, coefficients of correlation are shown between the index of concentration and the measure of coherence. In only two of the 18 cases was the coefficient of correlation significant at the generally

Table 6. Correlations between the index of static concentration (location quotient) and the index of coherence

State/Type of county	1977-82 Index	1982-87 Index
Iowa		
Farm	-.007[a]	-.202
	(.959)	(.143)
Metropolitan	.424	.744
	(.193)	(.009)
Nonmetropolitan	-.148	.299
	(.404)	(.194)
Minnesota		
Farm	-.160	-.298
	(.538)	(.245)
Metropolitan	.422	-.019
	(.099)	(.946)
Nonmetropolitan	-.061	-.194
	(.754)	(.311)
Wisconsin		
Farm	-.069	.739
	(.814)	(.003)
Metropolitan	-.110	-.361
	(.655)	(.129)
Nonmetropolitan	.205	.231
	(.223)	(.169)

[a]The unbracketed figure is the estimated value of the coefficient of correlation. The associated bracketed figure is the confidence level for a test that the estimated value is zero.

accepted 5 percent level of confidence or better. In both of these cases, the correlation was positive. We would anticipate a positive correlation under the traditional view, since higher industry concentration would imply local dominance by an industry and presumed overdependence. However, jumping to the much more generous level of acceptable significance of 20 percent, there was still little evidence of the type of correlation that one might have anticipated for counties dominated by a single sector. In only eight cases were the coefficients significant at this very low statistical significance level. In six of these cases, the sign was positive. The evidence of the positive correlation was evident, but it was fairly weak.

In sum, the correlation between the traditional static measure of economic diversity and our measure of dynamic coherence was generally weak. This indicated that the traditional measures of dominance of a region by an industry do not really measure the extent to which other sectors are driven by one particular sector. If the traditional concentration measures really measured the extent to which one industry actually drove the performance of all sectors in the economy, then these correlations would have been much higher.

Conclusion

This project developed and demonstrated a new and nontraditional technique for evaluating the developmental performance of a local or county economy. This measure, the index of dynamic coherence, measures the extent to which a change in the level of employment in a county

represents a deepening of the local economic infrastructure through the development of tighter interindustry relationships. It has been shown that this index of economic coherence can be an important indicator of the types of local economies that may have developed the potential for future growth. It is emphasized that this coherence can be achieved by linkages in economic processes across sectors, or by institutional structures of communities.

It has also been argued that some of the empirical concepts used to measure economic diversity may be too naive and incapable of measuring the extent to which an economy is, in fact, dominated by an industry. Economic development should not be viewed or monitored simply in terms of its impact on the change in the level of income or employment (although this is surely one of the pleasant correlates of a developing region). Particularly in smaller communities, the commitment of a prospective new employer to the local economic community is important for the development of the long-term growth potential of the economy. The fact that the coherence measure is not based on the idea of a production function, as is input-output analysis, opens up a number of ways to interpret it, including institutional settings in communities that reinforce comovement in industries or sectors.

Appendix Table A.1. Relationships between changes in index of coherence and total employment growth rates: Iowa

Index of coherence/ Two periods	Farm		Metropolitan		Nonmetropolitan	
	Above[a]	Below[a]	Above	Below	Above	Below
Always above average	7	9	1	1	5	2
Always below average	7	9	3	1	2	5
Below to above	3	8	2	1	7	3
Above to below	8	3	1	1	4	6

[a]Above and below average rates of growth in total employment.

Appendix Table A.2. Relationships between changes in index of coherence and total employment growth rates: Minnesota

Index of coherence/ Two periods	Farm		Metropolitan		Nonmetropolitan	
	Above[a]	Below[a]	Above	Below	Above	Below
Always above average	1	5	4	0	5	1
Always below average	5	0	1	2	2	3
Below to above	1	2	3	1	5	4
Above to below	2	1	2	2	6	3

[a]Above and below average rates of growth in total employment.

Appendix Table A.3. Relationships between changes in index of coherence and total employment growth rates: Wisconsin

Index of coherence/ Two periods	Farm		Metropolitan		Nonmetropolitan	
	Above[a]	Below[a]	Above	Below	Above	Below
Always above average	1	2	5	3	7	3
Always below average	2	1	2	5	5	5
Below to above	4	0	1	1	5	4
Above to below	1	3	0	2	4	5

[a]Above and below average rates of growth in total employment.

References

Bender, Lloyd, B. L. Green, T. F. Hady, J. A. Kuehn, M. K. Nelson, L. B. Perkinson, and P. J. Ross. "The Diverse Social and Economic Structure of Nonmetropolitan America." Rural Development Research Report 49. Economic Research Service, U.S. Department of Agriculture, Washington, D.C.

Fomby, T. B., R. C. Hill, and S. R. Johnson. 1984. Advanced Econometric Methods. New York: Springer-Verlag New York, Inc.

John, D., S. S. Batie, and K. Norris. 1988. A Brighter Future for Rural America? Strategies for Communities and States. National Governors' Association, Washington, D.C.

Richardson, H. W. 1979. Regional Economics. Urbana: University of Illinois Press.

Sommer, J. E., and F. K. Hines. September 1988. The U.S. Farm Sector: How Agricultural Exports Are Shaping Rural Economies in the 1980s. Agriculture Information Bulletin Number 541. Economic Research Service, W. S. Department of Agriculture, Washington, D.C.